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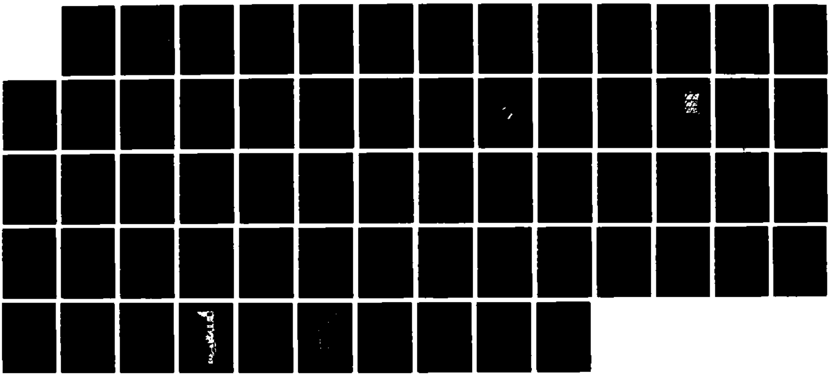

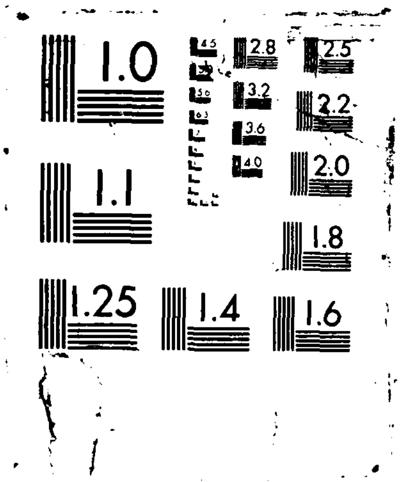
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BETTER FACILITIES THROUGH DESIGN STANDARDIZATION

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Executive Summary

BETTER FACILITIES THROUGH DESIGN STANDARDIZATION

An effective design standardization program promotes the use of successful facility designs. By basing designs on past successes, design standardization improves the likelihood that new facilities will be responsive to user requirements and can reduce the time for facilities programming, design, and construction.

Most DoD design standardization occurs at two levels: "standard designs" that include construction drawings and specifications for complete facilities, and "design criteria" for general facility planning. Little is done at intermediate levels of standardization: "definitive drawings" that show less detail than standard designs, and "functional modules" that address relationships within facility elements (e.g., room types). A more balanced program is needed to realize the full benefits of design standardization. We recommend that the Deputy Assistant Secretary of Defense (Installations) [DASD(I)] move to a program that uses all levels of design standardization.

The DASD(I) should establish an OSD design standardization committee headed by his Director of Construction to identify the facility types that are candidates for design standardization. The committee would also establish design standards appropriate for DoD-wide use. In turn, Service-level committees would establish design standards at levels appropriate for their own organizations.

We also recommend that the Director of Construction conduct a limited test of the program, and if it is successful, proceed with full scale implementation.

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1. INTRODUCTION

Design standardization of facilities is a process in which successful designs or elements of those designs are repeated in the designs for a number of similar facilities. Design standardization can lead to better facilities at the same or often lower costs.

The Department of Defense (DoD) has used design standardization with differing degrees of success for a number of years. (A brief history of DoD design standardization efforts is presented in Appendix A.) DoD currently specifies the use of standard designs (site adaptations of previously built designs) in about 5 percent of its design directives. In some cases, the designs are satisfactory, but in many cases, the standard design either does not adequately meet the needs of the user or requires major modifications that eliminate or reduce any benefits that might be realized.

DoD was a leading advocate of standard designs in the 1950's and 1960's. In recent years, its use of standard designs has generally decreased with the exception of occasional interest in specific facility types such as barracks. Primary interest has been focused on building the most functionally efficient facility and reducing the cost of the completed facility through the use of design standardization. Much of that interest has been directed toward pre-engineered buildings and pre-manufactured units or components. The advent of computer-aided drafting and design (CADD), with its capability to store, rapidly retrieve, and easily modify data, has further heightened the interest in the standardization of facilities' design. Thus, DoD is currently re-examining its policy toward design standardization to ensure it is taking advantage of any cost or quality of construction benefits that a standardization program can offer.

To provide DoD with a consistent and effective approach for design standardization, we have assessed its advantages and disadvantages and recommend use of a standardization matrix approach that takes into account the organization and the most appropriate degree of standardization.

In Chapter 2, we define four levels (degrees) of standardization and correct some misconceptions about one of the levels – standard designs. Chapter 3 discusses the benefits of design standardization and why an organization would want to standardize. Chapter 4 examines the issues DoD must consider when developing a design standardization program, and Chapter 5 presents a recommended DoD design standardization program and suggestions for its implementation. More detailed information on facility design standardization is given in the appendices.

2. LEVELS OF STANDARDIZATION AND STANDARD DESIGN MISCONCEPTIONS

In this study, we have considered the various degrees of design standardization and have divided them into the following four levels on the basis of the degree of standardization achieved.

- Standard Designs (Level 1)
- Definitive Drawings (Level 2)
- Functional Modules (Level 3)
- Design Criteria (Level 4).

STANDARD DESIGNS

The use of standard designs provides the greatest degree of standardization. Standard designs are complete construction drawings that include materials, systems, and assembly details and cover all aspects of construction. This approach – the use of standard designs – has historically had the greatest influence on facility standardization.

DEFINITIVE DRAWINGS

The use of definitive drawings provides a somewhat lesser degree of design standardization. They consist of single- or double-line floor plans that show space allocation, functional layouts, special features and requirements, and configurations for a complete facility. However, they are not prepared in sufficient detail to be used for the construction of the facility.

FUNCTIONAL MODULES

Functional modules are single-line drawings that delineate the relationships of specific activities contained within functional elements such as room types and the like. The use of functional modules is an approach that has gained popularity in recent years and is thought by many in the construction industry to be the design methodology of the future. Its popularity can be traced to the proliferation of CADD and the flexibility of a CADD-based modular approach.

DESIGN CRITERIA

The fourth level of design standardization – the use of design criteria – provides the least design standardization. Design criteria are the written and graphic programmatic guidance describing the general standards and requirements necessary to meet DoD and Military Department regulations and directives. Criteria that describe the design requirements for a project are used by most owners and builders. Facilities can be standardized to a certain degree depending upon the level of detail that exists in the criteria – the more detailed the criteria, the more influence they have on the facility design standardization.

MISCONCEPTIONS CONCERNING STANDARD DESIGN COST SAVINGS

A number of misconceptions exist about the cost savings associated with standard designs, and we have identified four major ones that are widely held by the engineering community. These misconceptions distort the analysis of standard designs and their worth and have frequently led to poor management decisions on the use of design standardization.

The first misconception is that design costs are a significant part of total facility costs. When life-cycle costs of a facility are calculated, design is less than 2 percent, with the remaining 98 percent being associated with constructing, outfitting, and operating a facility. Construction normally involves between 40 and 44 percent of the total costs, while outfitting and operating the facility costs 54 to 58 percent of the total. Design costs are an even smaller portion of functional operating costs (the manpower and other costs associated with the mission that the facility supports). When design costs are compared to total costs (construction, outfitting, operating, and functional operating costs), they are too small to be measured. Design costs, as such a small part of the total costs, offer the least potential for significant dollar savings.

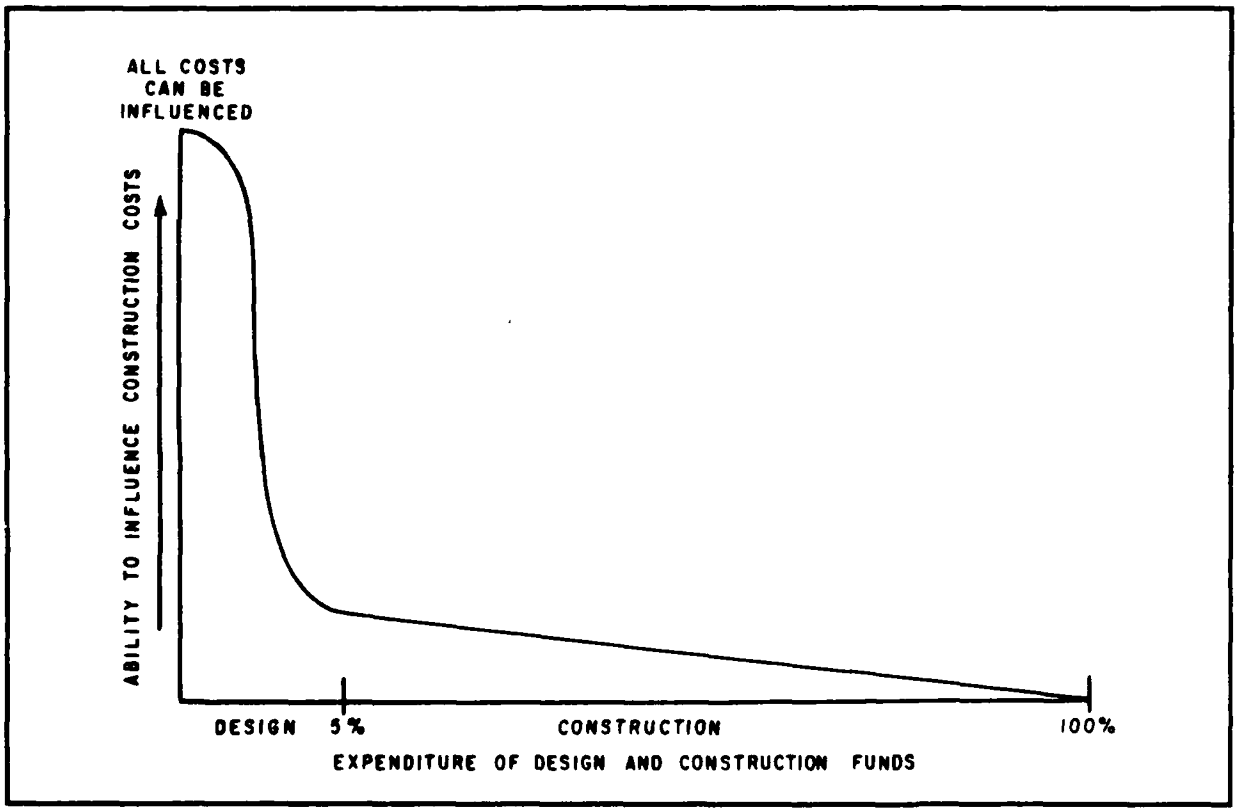
A second misconception is that standard designs are satisfactory for all facilities and at all locations and can, therefore, lower design costs. We have identified 13 factors upon which design solutions depend. Those factors often make the use of standard designs impractical. By subject area, they are:

- External environmental loads
  - Wind loads
  - Snow loads
  - Rain
  - Temperature differentials
- Internal environmental loads
  - Humidity
  - Solar gain
- Seismic loads
- Foundation conditions
- Site characteristics
  - Topography
  - Size
  - Shape
  - Access
- Use of locally preferred materials and trades.

Differences in environmental loads, both external and internal, can require major design changes. Wind and snow loads affect structural systems; rain, temperature differentials, and solar considerations can dramatically affect the selection of materials for the building envelope; and humidity and solar gain (as well as temperature differentials) may dictate widely varying solutions to heating, ventilating, and air conditioning problems. Designing for seismic conditions can necessitate greatly differing solutions to structural issues, foundation treatments, and wall systems. Foundation systems are almost always a problem and frequently require the use of different techniques for the same building to deal with varying soil bearing capacities and ground water conditions. For example, a choice must often be made among spread footings, piles, and a floating foundation. Each foundation technique has associated structural considerations, such as the distribution of point loads, treatment of horizontal thrust, etc., that can in turn affect utility locations, duct placement, etc. The site can also become a variable because topography, size, shape, and access to the site must be considered. A final factor that can have significant cost implications is the use of locally preferred materials and trades. In some parts of the country, tilt-up concrete construction is used extensively and is very cheap, while in other locations it is expensive. The same can be said of precast concrete, masonry, etc. Similarly, the current availability of selected trades may make certain types of construction cost-prohibitive. For example, a shortage of masons may rule out masonry construction, brick veneers, or concrete masonry units. Those factors can frequently change a standard design from a "winner" (i.e., one that meets the requirements of the new facility without costly redesign) in one location to a "loser" (i.e., one that requires costly redesign to meet new facility requirements) in another location.

Another, and particularly costly, misconception is the notion that reducing design costs is the best way to save money when procuring facilities. Facility costs are most readily influenced (reduced) during the design phase, and thereafter, the ability to reduce cost declines rapidly with time (see Figure 2-1). Fortune 500 Company owner/builders feel that 60 percent to 70 percent of the construction costs are set by the time 90 percent of the design is complete. Thus, the most effective time and place to reduce facility costs is during the design phase. Those cost reductions are not realized by reducing design costs but rather by performing intelligent analyses that reduce construction costs. Such a philosophy has been addressed by the Construction Industry Cost Effectiveness (CICE) studies and is being adopted by many large owner/builders. One owner/builder in the top ten of the Fortune 500 Companies felt that construction and outfitting costs could be reduced by 10 percent during design by doing "smart" things. Many other owner/builders also feel that way and are willing to put additional money into design to realize the larger construction savings.

FIGURE 2-1. THE ABILITY TO INFLUENCE FACILITY CONSTRUCTION COSTS



A final misconception is the feeling that standard designs are always less costly than "from scratch" designs. Earlier, we presented 13 factors that affect the feasibility of transferring standard designs. In the design phase, redesign and false starts are very costly in terms of both dollars and time. When standard designs are "losers," they are more costly than "from scratch" designs. Problems with adapting standard designs to sites can result in design costs increasing by 40 to 60 percent.

It is also difficult to realize design savings even in situations in which a standard design is a "winner." A major reason for this is Architect/Engineer (AE) liability. The current trend is to hold the designer liable for facility problems that are thought to result from poor or negligent design. Because of that liability, an AE using another firm's design must thoroughly verify the design. The verification often involves an effort as great or greater than that required for the initial design. An exception to this verification occurs when an owner adapts the design with his own work force. In such cases, design costs may be lowered by 30 percent to 40 percent, but the owner has assumed liability for the design by virtue of the modifications that he has made. Consequently, few owner/builders are able to realize significant savings from the site adaptation of standard designs for any but very specialized facilities.

3. THE BENEFITS OF DESIGN STANDARDIZATION

Our assessment of the private and public sectors indicates a significant trend toward design standardization, particularly in well-managed organizations. However, we found no instances in which builders attempted to site-adapt complete building designs. (Appendix B lists organizations and individuals contacted while conducting this assessment.)

PRIVATE SECTOR EXPERIENCE

In large private sector companies that build on a regional or national scale, the use of repetitious elements plays a major role in the planning, design, and construction of facilities. All of the organizations contacted use a high degree of repetition when it comes to design criteria, modular elements of floor plans, materials/equipment, construction details, and to a lesser degree, exterior treatments.

Builders in the private sector did not use standard designs (Level 1) because most felt that they were too expensive and did not save any money in the actual construction process. The most interesting response came from the leading fast-food company in the United States. Its chief architect said, "We've been trying to simplify the process and adopt a few basic designs for years, and it just doesn't work." That company builds approximately 450 to 500 restaurants a year and has been unable to develop a "standard design" that does not require extensive alterations and that will be current for more than 2 years.

Most builders and owners agree that the driving force behind design standardization is cost savings. Cost savings are achieved from reduced design and construction time, the reduced number of errors in contract documents, and the lower life-cycle costs of the facility. Cost savings are not achieved in the design process itself. In fact, ample evidence indicates that these organizations recognize the folly of trying to save money in the design process because of its impact on the cost of the rest of the project.

In the private sector, design and construction programs of many companies have a number of similarities. For example, they have strong central direction of the standardization program, extensively use feedback of lessons learned throughout the entire process, and integrate design standardization as a normal and fundamental part of day-to-day business. Their approaches to managing construction projects also have many similarities, among which are:

- Authority and responsibility are focused.
- Improved efficiency is constantly sought.
- Incentives are to reduce costs, not expand them.
- Innovation is encouraged even at the risk of making mistakes.
- Advanced technology is used.
- Decisions are made thoughtfully but only at one level of the organization.

The common denominator in all private sector design standardization was the desire to focus on time, efficiency, quality, and the free exchange of information among all elements of the organization.

POTENTIAL DoD BENEFITS

The driving force behind most DoD efforts to implement some level of design standardization is a perception that such a procedure will lead to a reduction in the cost of design. Although there is a small element of reality in this perception, the advantages of a well-conceived design standardization procedure lie primarily in its ability to:

- Provide a feedback mechanism so that past successes and failures can be used to help meet a facility's operational requirements
- Increase the efficiency of resource programming
- Improve the responsiveness of the completed facility to the needs of the user

- Promote more cost-effective construction
- Increase senior management control and accountability
- Provide equitable facilities for all DoD personnel.

These advantages combine to create a comprehensive design and construction program that improves the quality of the products delivered, reduces errors, enhances durability and maintainability, sharpens cost control and predictability, and supports the concept of more construction for the money in terms of design, construction, and total life-cycle costs.

The feedback mechanism of lessons learned from experience is a fundamental tenet of all well-managed design standardization programs. By learning from the mistakes of the past and applying that experience to the solution of problems at hand, facilities will be built to meet operational requirements and are less expensive to operate and maintain. (For example, when we finally design a roof that does not leak, why insist on finding other designs that leak.) Facilities constructed by a program that has an integral feedback loop in the planning, design, and construction process will be more responsive to mission needs by incorporating "designs that work" and will have the latest technologies.

An effective design standardization program can increase both the efficiency of programming and the responsiveness of the completed facility to the needs of the user by making some decisions for the designer at the beginning of the design process. By providing answers to generic problems, design standardization permits the designer to concentrate on project-specific issues, and that concentration normally results in a clearer idea of the facility requirements during programming. It also helps ensure that critical users' needs (they should be part of a standard) are being addressed in the design. The result is fewer false starts in programming and a more functional facility.

Another benefit of design standardization is an increase in the control of senior management resulting from the clear delineation of responsibility and authority at each level. The design of a facility has a tremendous impact on the mission that the building ultimately supports, and that mission must be supported long beyond the term of any individual commander. The local commander rarely has either the training or the experience to make the best decisions on engineering and design issues; however, he is very concerned with the ability of the facility to support his mission and how it fits in with his post. An important characteristic of any standardization program is that key decisions are made at the most appropriate (i.e., the most qualified) level of the organization, which implies that managers at the local level should be given a clearly defined set of authorities regarding the design and construction of facilities. This method of organization leads to better control and accountability at senior management levels as well as throughout the chain of command.

Of the building types in the DoD that require uniform quality, the most obvious example is housing. Each Service strives for housing equity within its inventory, and to a large extent, DoD strives for equity among the Services. A well thought out standardization program can be an integral part of efforts to achieve equitable facilities within DoD. Standards permit the description of minimum acceptable facilities. These descriptions can be used to foster equity within DoD and/or the Services.

4. KEY DoD DESIGN STANDARDIZATION ISSUES

DoD needs to address six major issues when developing a standardization program. Three of these issues concern standardization decisions, and three concern standardization processes.

DECISION-ORIENTED ISSUES

The three decision-oriented issues facing DoD are the determination of the appropriate level of standardization, the selection of facilities to be standardized, and the designation of organizations or individuals to make standardization decisions.

Appropriate Level of Standardization

An appropriate level of standardization is determined on the basis of a number of factors. The most important factors are the applicability of standardization for the category of facilities under consideration, the costs to achieve and maintain the level of standardization, and the benefits that can be expected from the level of standardization being considered.

The applicability of standardization to any given facility type is determined by the function that the facility must perform and the degree to which the functional requirements are consistent from organization to organization. Some facilities lend themselves to a higher degree of standardization than others. Applicability is also a function of the organization that is attempting to standardize. A facility that may not have consistent functional requirements at the DoD level may have sufficient consistency at the Service or major command level to warrant standardization.

The costs and benefits play a key role in selecting the appropriate level of standardization for a facility. Establishing and maintaining any type of standard is expensive. The greater the degree of standardization (i.e., the higher the level), the greater the expense. It is not prudent to establish a standard unless there is a reasonable expectation that significant benefits (as described in Chapter 2) can be obtained by standardizing at the level under consideration. Even if costs and benefits can not be quantified exactly, an analysis of their potential impacts should be part of the decision process for determining the appropriate level of standardization for any facility type.

Selection of Facilities

The selection of the facilities to standardize is a critical part of any standardization policy. A major problem with many past DoD standardization efforts was the number of facility types that it attempted to standardize. Failures of many of the past standardization attempts can be traced to the large number of facilities that were included in the effort. The resource requirements to maintain the standards can quickly become burdensome, and as a result the standards are not maintained and, thus, do not address current needs. They then fall into disuse. The facility types to be standardized must be limited by the number of facilities expected to be built over the next 1 to 5 years and the benefits expected to be generated by having a standard. As with the determination of the appropriate level of standardization, facilities not selected for standardization at the DoD level may be selected at the Service or major command level.

Standardization Decision-Making

A number of decisions must be made when implementing and administering a standardization program. The success of the policy is highly dependent on ensuring that those decisions are made by the most appropriate individuals. Decision-making authority should be placed where the decision-maker has sufficient organizational authority to influence those who will use the standard as well as an adequate background to make correct judgments on functional requirement issues. By organizational authority, we mean the authority that is associated with a position in an organization. The commander of a major command, for example, has a great deal of authority within his organization as do his direct representatives. A frequent problem with past standardization efforts was the lack of command authority behind standardization decisions. Consequently, standards were ignored and had very little impact on the design of facilities.

PROCESS-ORIENTED ISSUES

A number of issues concerned with the design standardization process deal with the procedures, information flows, and operating concepts to be employed in a standardization policy. The most important of these issues are the feedback of lessons learned, the integration of a standardization program into the normal business routine, and the impact of computers (specifically CADD) on the design process.

Feedback of Lessons Learned

Learning from experience is an important part of any standardization effort; *feedback from completed projects is the process that permits this learning.* However, merely recording feedback from completed projects is not enough. It is critical that such feedback results in decisions or actions. An appropriate analogy can be made with a thermostat. Temperatures can be recorded day in and day out, but if an action (turning a piece of equipment on or off) does not occur, the thermostat is of little value. The same can be said of feedback from completed facilities. Recording information is of little value if it does not result in positive actions or decisions. A successful standardization effort should ensure that feedback is being incorporated into standards, and that lessons learned from experience are not being lost in computer data files.

Integration of the Standardization Program

A successful standardization effort must be an integral part of the normal business routine of an organization. Part of this integration consists of having standardization automatically considered in the design process. Procedures are needed which ensure that standards are incorporated into designs when they exist for the facility type under consideration. A common way of doing this is by specifying in existing programming guidance or design directives that a standard will be used. The procedure should be part of a normal business routine for the organization and should require little, if any, additional effort.

Similarly, automatic checks should be established to ensure that programming guidance and directives are being met. In most organizations, this checking is done as a matter of course and simply involves adding another item to an existing check list. Failure to follow up on the use of standards can be as serious a shortcoming as failing to initiate them in the first place.

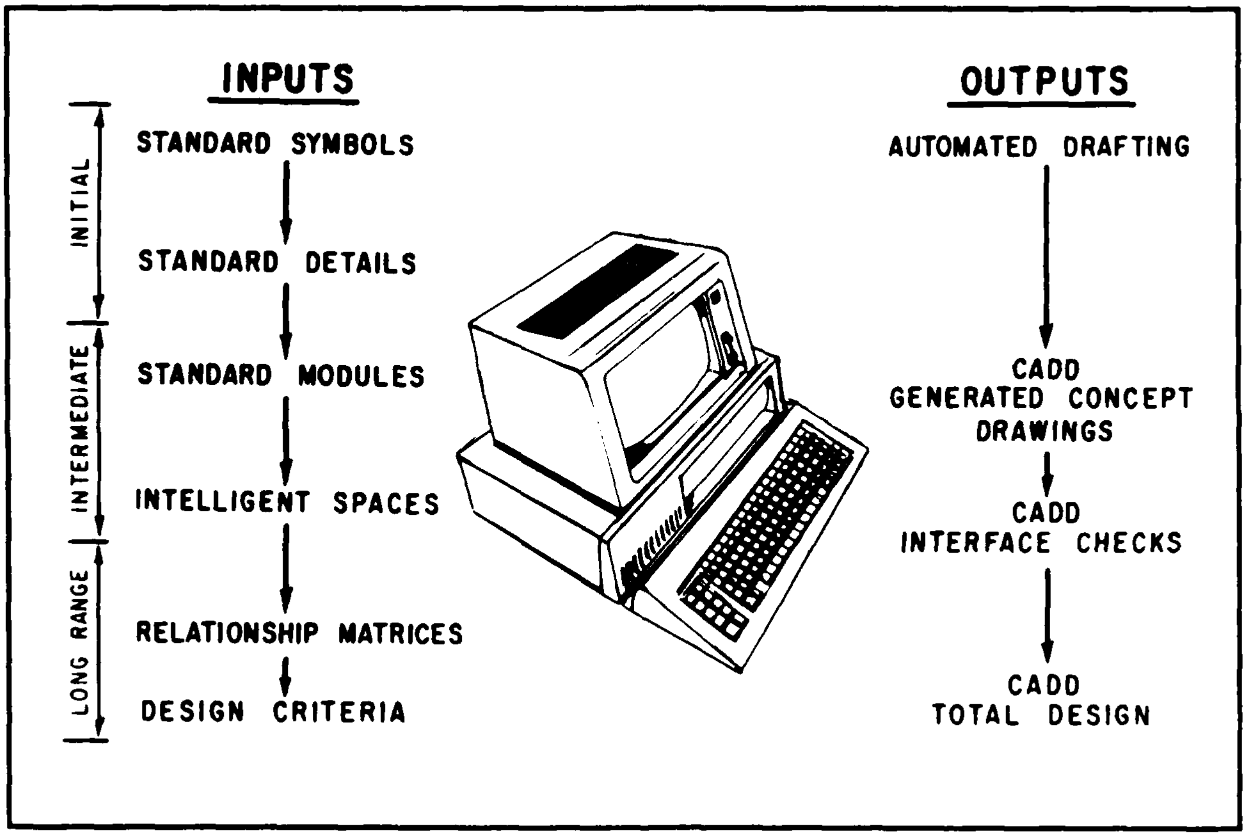
Computers in the Design Process

Computers are having a major impact on the design process. Decreasing hardware and software costs are making the utilization of computers not only desirable, but essential. With current technology complete designs can be executed on computer screens. Such efforts are still beyond the capabilities of many designers, but it is merely a matter of time until the keyboard replaces the drafting table. Most progressive designers are currently using computer-aided drafting to increase production and minimize errors, and as the technology is refined and becomes more affordable, designing will be incorporated along with drafting on the same machine.

The capabilities of CADD are currently used by many large owners and builders. Common areas of application are hospitals, office buildings, fast-food outlets, and hotels. One problem that has slowed the spread of CADD is that machines made by different manufacturers have difficulty in communicating with each other. This problem is being addressed and solutions are beginning to appear. Two of those solutions are the use of standard formats such as standard interchange format (SIF) and initial graphics exchange specification (IGES). Although SIF and IGES have limitations, they are the first step toward eliminating problems with data exchange between CADD machines. When completed, this will greatly increase the usage of CADD.

An effective standardization program should recognize the potential of CADD and should permit capitalization of its advantages. The inputs that are required to obtain these advantages (outputs) are shown in Figure 4-1. Major

FIGURE 4-1. COMPUTER-AIDED DRAFTING AND DESIGN



elements of a standardization process that would serve as inputs to CADD are standard symbols, standard details, standard modules, intelligent spaces (power and ventilation requirements assigned to the spaces), relationship matrices (numeric representations of space-to-space relationships), and design criteria. Although the use of all of these inputs is beyond the capability of most current CADD users, they will be needed in the future if the full potential of CADD is to be reached and should be considered when developing a standardization program.

5. A RECOMMENDED DESIGN STANDARDIZATION PROGRAM FOR DoD

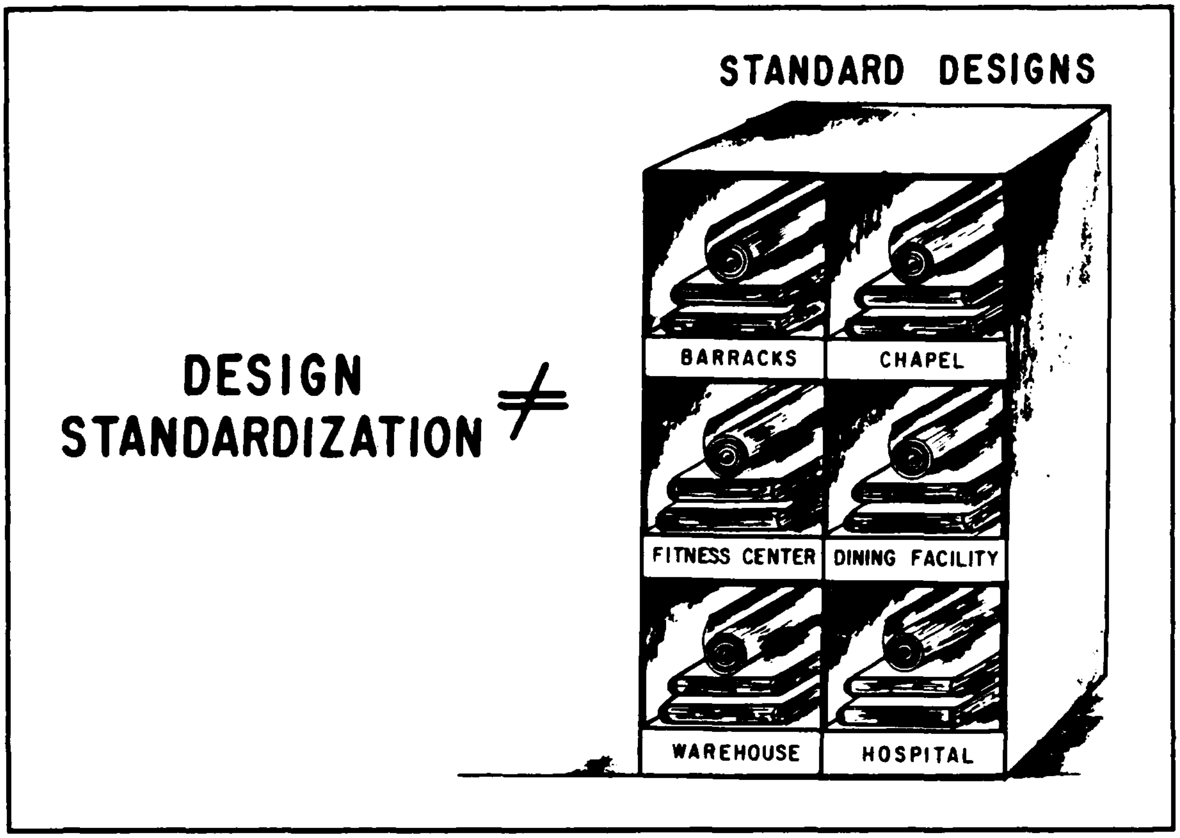
An effective DoD standardization program must address the six issues cited in Chapter 4. Failure to recognize the importance of decision-oriented issues such as the determination of the appropriate level of standardization, the selection of facilities to be standardized, and the designation of organizations or individuals to make standardization decisions can doom a standardization effort. The same is true of the major process-oriented issues. The feedback of lessons learned, the integration of the standardization effort into the normal business routine, and the impact of CADD must all be incorporated into the standardization program. Only by addressing all of these major issues can the potential benefits of design standardization be realized.

THE DESIGN STANDARDIZATION PROCESS

As discussed in Chapter 3, DoD could realize many potential benefits from increased design standardization and should adopt a standardization program that permits it to do so. However, in developing a design standardization program, care must be taken to distinguish design standardization from standard designs (Level 1) (see Figure 5-1). An effective design standardization program should recognize that **process flexibility** is the key to success. As discussed in the previous chapters, no single solution exists for all design standardization issues. Rather, the solutions can be thought of as a matrix that addresses the multi-level and multi-organization aspects of standardization.

Part of the flexibility needed in a standardization process is the recognition that different levels of design standardization are necessary. These different levels (Levels 1 through 4), as described in Chapter 2, constitute one axis of the standardization matrix (Figure 5-2). A DoD program must be able to identify and select the level of standardization that is appropriate for a facility type. The second axis of the

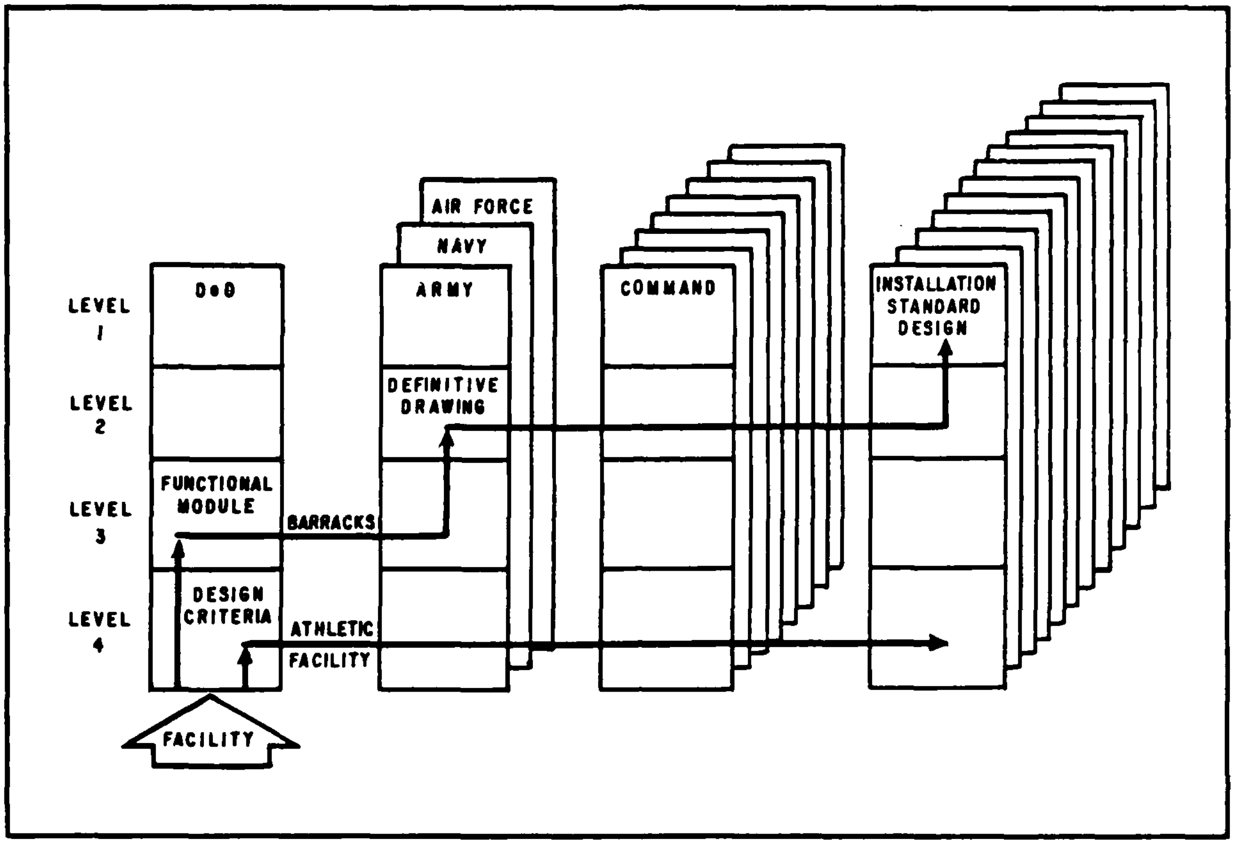
FIGURE 5-1. DESIGN STANDARDIZATIONS VS. STANDARD DESIGNS



standardization matrix is the organization for which the standard is being developed. The level of standardization may change from organization to organization, and in general, most facilities will become more standardized (nearer to Level 1) as the organization at which standardization decisions are made approaches the installation level. This process is shown graphically in Figure 5-2.

Facilities selected for standardization should be analyzed in a systematic approach that begins by assuming that no level of standardization is needed. The analysis would begin with Level 4 at the DoD. The criteria for determining whether Level 4 standardization is appropriate would be reviewed; if the answer is yes, the criteria for Level 3 would be checked, and so on (detailed descriptions of the decision criteria are presented in Appendix C). The process would move horizontally to the

FIGURE 5-2. THE DESIGN STANDARDIZATION PROCESS



Services when the criteria were not satisfied for a level. The analysis would continue through the four levels of organization: DoD, the Services, major commands, and when appropriate, installations. Standards could potentially exist at different levels for each grouping of organizations. Each organization grouping would be required to use at least the level of standardization identified by senior organizations, but would be permitted to establish a higher level of standardization if it felt that the criteria were met. This approach would be followed for all facilities that are selected for standardization.

Two hypothetical examples of this approach are depicted in Figure 5-2. In the first example, Level 3 is chosen as the appropriate level of DoD standardization for barracks, and a DoD functional model will be developed as a result of that decision.

The Services, after examining the criteria, decide that Level 2 design standardization is appropriate for them and establish definitive drawings. In the example, no major command feels that it should standardize at Level 1; however, some installations feel that it is appropriate for them to have Level 1 standardization. Those installations, in consultation with their design and construction agents, would then select standard designs from existing successful projects to be used on their installations. (Exemplary barracks standards for all four levels are presented in Appendix D.)

The second example, athletic facilities, shows that the criteria for moving beyond Level 4 standardization were not met by any grouping of organizations. Therefore, only DoD design criteria would exist for athletic facilities. Both examples are hypothetical but illustrate the concept that different design standardization solutions are available for different facility types.

Involvement in the design standardization process of operations personnel familiar with the operational aspects of a facility is an important part of a DoD standardization policy and must be considered in two ways. First, decisions on the design of the facility itself must be made by the appropriate personnel in an organization. These personnel are not always the end users because each end user may have a very different (and not necessarily correct) idea of what is needed. The appropriate individual is someone who has operational experience but is in a position to assess the broader organizational requirements as they exist and as they are expected to exist in the future. This person should provide a degree of uniformity while ensuring that operational needs are met. The second consideration is that there be high-level involvement within each organization. General officers will have to become involved at the Service, major command, and installation levels if design standardization is to be supported. Operational commanders and their representatives who are responsible for making standardization decisions are a key part of the DoD standardization program.

DESIGN STANDARDIZATION PROGRAM

The recommended DoD design standardization program involves four steps: identifying the facility types to be standardized, establishing design standardization committees, selecting the level of standardization for a facility type, and developing the standards at the levels chosen.

Identifying Facility Types To Be Standardized

The first step of the design standardization program is to identify those facilities that will be candidates for standardization. Among the many factors that can be considered, the two most important are the number (dollar volume) of the facilities being built and the policy issues involved (e.g., equity considerations, etc.). We developed a list of potential facilities by examining the 1986 Military Construction (MILCON) appropriation and identifying the six facility types with the largest percentage of the program (by dollar volume). These six facility types account for more than 80 percent of the 1986 MILCON program. Proposed construction programs for FY87 to FY90 for the Naval Facilities Engineering Command (NAVFAC) and the U.S. Army Corps of Engineers (COE) were examined to see whether a major shift in the type of facilities to be built was expected. No change was noted in the list over the 5-year period although the relative position of the top four on the initial list shifted somewhat. The six facility types are shown in decreasing order of dollar volume.

- Unaccompanied enlisted housing
- Maintenance facilities
- Training facilities
- Operations buildings

- Dining facilities
- Medical clinics.

The list of most frequently built facilities should be viewed as the first cut for identifying facilities for standardization. Some of the facility types represent an aggregation of facilities and require some disaggregation before design standardization decisions can be made. This disaggregation can occur in most cases at the Service level and is an indicator that DoD design standardization beyond Level 4 will not occur frequently. Some facility types clearly lend themselves to inclusion in a standardization program because of the standardized nature of their functional requirements. Examples of these are unaccompanied enlisted housing, dining facilities, and medical clinics. Another category of facilities that should be added to the list of those being considered for standardization are facilities that should be standardized for equity or policy reasons. Examples of these are DoD-built schools, child care centers, visiting officer quarters, family centers, etc. These facilities should be added to those most frequently built to make a consolidated screening list.

Establishing Design Standardization Committees

A committee, or a group of committees, should be established at each organizational level at which standard design decisions will be made. The committees are responsible for selecting facilities for standardization, for determining the appropriate level of standardization, for developing standards, and for ensuring that the standards are maintained. The committees should be special advisory groups to the organization commander and their decisions should be issued under his signature. The design and construction agents should be secretaries to those committees and provide the technical and administrative support necessary to make them function. The exact make-up of Service, major command, and installation committees should be decided by the organization, but we recommend that it parallel the DoD organization shown below.

- OSD Director of Construction-Chairman
- OSD Subject Area Representative
- Army Subject Area Representative
- Navy Subject Area Representative
- Air Force Subject Area Representative
- Marine Corps Subject Area Representative
- NAVFAC Representative
- COE Representative
- Air Force Engineering and Services Representative.

The Services should be free to select their subject area representative for DoD committees; however, a logical choice would be an individual from the resource sponsor for the subject area under consideration, such as the Deputy Chief of Staff for Personnel when barracks are being considered. At the DoD level, we recommend that Service engineers provide technical support, propose standards, and maintain the standards once they are selected. A representative of the DoD Director of Construction Office should serve as the chairman of the group. The number of these committees established depends upon the number and type of facilities that are selected for standardization.

The responsibilities are basically the same for all committees. Committees select facilities to be standardized, choose the appropriate level of standardization, select and approve the standards, and maintain the standards that they have selected. The maintenance of the standards is a technical activity that should be done by the Service engineers. Maintenance can be divided into two parts; additions or deletions to the list of standards, and incorporation of feedback into the existing standards.

Standards should be added or deleted whenever policy or program changes materially alter the requirements for a facility type. Additions and deletions should be decided upon by the appropriate committee.

Feedback is a critical part of the standardization program and must be actively managed. We recommend that the existing feedback mechanisms employed by the COE and NAVFAC be used to support the DoD standardization program. We recommend that the following changes be made to their existing policies in order to ensure that the maximum return on resource investment is obtained. First, post-occupancy evaluations scheduled for facilities that are standardized at Level 2 or higher should be given the highest priority. Performing post-occupancy evaluations when there is no standard upon which to make decisions is normally of limited effectiveness. Second, on a semiannual basis, selective data dumps of COE and NAVFAC automated lessons learned data bases should be done for those facilities for which DoD has standardized at Level 2 or higher. The DoD design standardization committee should review those data dumps to see whether the DoD standards should be revised. A similar process should occur at the Services, major commands, and installations, with COE and NAVFAC providing technical assistance and continuity.

Selecting the Level of Standardization

The level of standardization for any facility type is determined by the design standardization committee evaluating the facility type against a set of criteria (see Appendix C for the DoD criteria) established in the form of a decision process. A negative answer at any of the decision nodes results in no standard being developed at that level. If all answers at decision nodes are positive for that level, the next higher level of standardization is evaluated. The process is repeated until the level of standardization for that facility type is selected.

Developing the Standards

Once a level of design standardization is chosen, the standard must be selected. The design standardization committee should begin every standard selection process by examining designs for completed facilities that are recognized as being well-designed and meeting the functional requirements of the facility. COE and NAVFAC should submit "winners" to the committees for consideration. The emphasis should be on selecting "winners" and not using untried designs as standards. This applies equally to the selection of definitive drawings and functional modules. Floor plans or modules should be extracted from designs that are "winners." COE and NAVFAC by virtue of their technical experience have a major role to play in the selection and maintenance of standards.

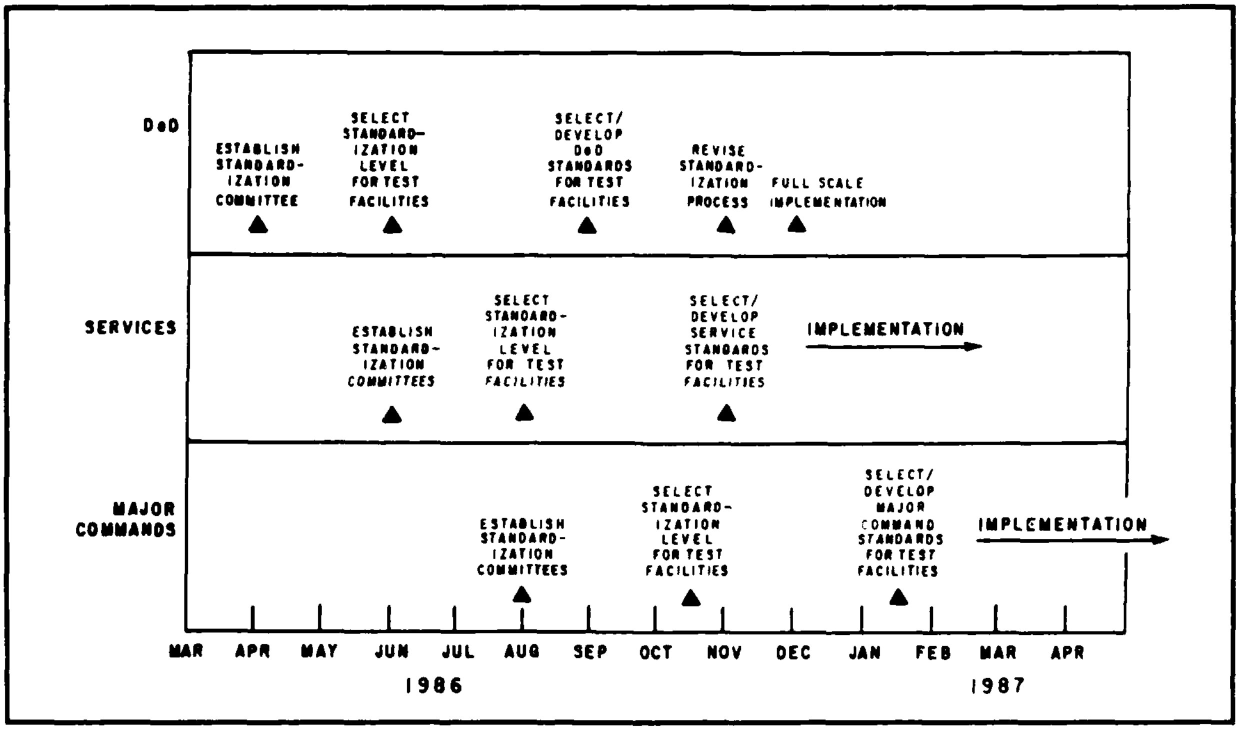
IMPLEMENTATION OF A DoD DESIGN STANDARDIZATION PROGRAM

Implementation of a design standardization program should begin with an initial test phase. The test phase should consist of conducting a limited test using a small number of facility types to check the validity of the process. The design standardization policy should be revised based upon the results of this test. Full-scale implementation should then take place.

We recommend that barracks, child care centers, and DoD schools be used for the initial test. After the test, a decision can be made on whether a different committee should be established for each facility type or whether a single standing committee with variable membership should be used. A test phase will also enable the Services, major commands, and installations to establish their committees with a manageable number of facility types before embarking on a major standardization effort. Most installations will probably not elect to establish design standardization committees initially unless they anticipate a significant amount of new construction for that facility type. In most cases, installations will rely on COE and NAVFAC to keep them advised of standardization developments. COE and NAVFAC should recognize this and select/develop regional standards when appropriate.

A milestone schedule for implementation of a DoD standardization policy is presented in Figure 5-3.

FIGURE 5-3. IMPLEMENTATION MILESTONE SCHEDULE



APPENDIX A

THE HISTORY OF DoD DESIGN STANDARDIZATION

The Department of Defense (DoD) has used some form of design standardization for a number of years. Its efforts have generally centered around the development and use of standard designs (complete sets of contract drawings and specifications cited in Chapter 2 of the text as Level 1 design standardization) that could be adapted to specific sites. The use of standard designs has been cyclical and has often been related to specific individuals who have been proponents of the approach. Interest in design standardization peaked in the late 1960's and early 1970's. During the late 1970's and early 1980's, DoD showed some interest in standard designs for specific facilities, but in general, the concept of standard designs was allowed to languish. Recently, however, interest has been renewed in the standardization of the design process.

(A distinction should be made between design standardization for mobilization facilities and that for the normal construction cycle. Designs for mobilization facilities have always been highly standardized. The Army has recently redone its mobilization drawings to take advantage of new construction techniques and computer-aided drafting and design (CADD) capabilities. Mobilization facilities do not have the same requirements as normal military construction (MILCON) and cannot be compared directly. Design life, timing, and the need for centralized control are just a few of the factors differentiating mobilization from MILCON facilities.)

STANDARDIZATION IN THE 1950's AND 1960's

DoD expended considerable effort on the development of standard designs in the 1950's. Architect/engineer (AE) firms were awarded contracts to develop books of standard designs that presumably could be adapted for use at any location. The primary objective of these standard designs was to decrease design costs by using off-the-shelf packages. Maintenance of the standard designs became highly resource-intensive, and updating of the standards began to lapse.

During the 1960's, emphasis on the use of standard designs increased. Many standard designs were updated; however, the major areas of emphasis were family housing and bachelor enlisted quarters (BEQ's). Equitable facilities within and among the Military Services were the primary concern. A Deputy Assistant Secretary of Defense (DASD) for Housing was established, and within that office, a Director of Design was responsible for directing the housing design effort. A number of standard designs for housing were developed during this period, and that emphasis continued throughout the decade. The use of standard designs, however, again declined at the end of the 1960's and in the early 1970's. The major reasons for that decline were the high costs of maintaining the standards and the emergence of horror stories about standard designs that were used inappropriately and resulted in facilities that did not work. By the mid-1970's the cycle again reversed itself.

RESURGENCE OF BEQ STANDARDIZATION IN THE 1970's

A resurgence in the use of standard designs for BEQ's began in the mid 1970's, impelled by the dual feeling that facility costs could be better contained with standard designs and housing equity could be attained. That standardization had mixed results. A 1978 Government Accounting Office (GAO) study attempted to show that the use of standard designs lowered the costs of barracks. However, the results were inconclusive because of the difficulty in separating all cost-causing factors, such as the bidding climate, differences in design requirements, geographic differences, etc. Once again, horror stories circulated about cases in which the use of standard designs forced the adoption of wrong solutions to facility problems. Among them was the barracks at Great Lakes Naval Training Center that had exposed exterior corridors that made returning to the barracks in the winter an adventure. In the early 1980's, the use of standard designs for barracks began to decline (no appreciable resurgence of standard designs for other facilities occurred during the 1970's).

CURRENT TRENDS

DoD influence on standard designs declined during the early 1980's. The decentralization of DoD functions eliminated many of the offices that had previously managed the use of standard designs at the DoD level, including the Director of Housing Design (one of the major proponents of standard designs). Few standard designs were maintained by the Services and DoD maintained none. DoD did, however, begin examining the use of standard modules and adopted a standard barracks room module. The Services utilized a number of different approaches to design standardization.

Army Design Standardization

The Army, through the Corps of Engineers (COE), is experiencing a renewed interest in design standardization. In recent years, it has concentrated its standardization efforts on certain selected facility types. Among the facility types on which the Army has concentrated its efforts are barracks, tactical equipment shops, and maintenance facilities. Historically, the Army has approached design standardization as the development of standard designs; recently, however, that approach has changed.

The Army, through COE, has begun examining the use of the modular approach to designing. It tried this approach on an experimental basis with the Building Standardization Design System (BSDS). However, BSDS was not as successful as desired. Its failure is due more to the execution of the idea than the idea itself. With the BSDS, the Army attempted to centrally design modular systems for a historically decentralized organization. BSDS was also predicated on a technology, CADD, with which COE was neither familiar with nor ready to accept.

A great deal of work on the modular concept and the formulation of modules has been done at COE's Construction Engineering Research Lab (CERL). CERL has developed a modular design approach that has been recently adopted by the Defense Communications Agency, and COE is considering use of the modular approach for other facility types.

The Army is now devoting effort to the development of an approach to design standardization that utilizes modules and maximizes the participation of operational personnel. COE has organized initial design standardization committees and is beginning to develop design standardization policy and procedures.

Navy Design Standardization

The Navy, through the Naval Facilities Engineering Command (NAVFAC), maintains few standardized designs and has taken a somewhat different approach to design standardization than the other Services. It is keenly aware of the resource requirement to maintain standard designs, and has recently emphasized the development of standard symbols and standard details that can be used with its CADD systems. The Navy is generally ahead of the Army in its use of CADD and has elected to devote its efforts at standardization toward those items that would increase its drafting productivity. It is also attempting to build a data base of standard designs by requiring each Engineering Field Division to submit two designs to NAVFAC Headquarters on CADD format. These designs are to be the beginning of a standard design data base. The Navy has done little to develop standard modules as a design standardization technique.

Air Force Design Standardization

The Air Force has some infrequently used standard designs, but has elected to devote most of its design standardization efforts toward developing and maintaining design guides. Some major commands within the Air Force have done some work with standard modules, but those modules have been developed primarily for support type facilities and their use is not widespread. The Air Force is also looking at the standardization of administrative spaces through the use of modular office equipment and under-the-floor electrical and communication ducts.

Army-Air Force Exchange System (AAFES) Design Standardization

AAFES uses a multilevel approach to design standardization. It uses standard designs as well as modules and definitive drawings to develop contract drawings. It has successfully used standard designs for small convenience stores located near housing areas (shoppettes). AAFES also uses standard floor plan configurations in conjunction with standard modules that are manually manipulated to develop definitive drawings. In its design effort, AAFES uses a computer-based system to assist in determining space requirements, but it does not have the construction volume to support the use of a CADD system.

APPENDIX B

ORGANIZATIONS AND INDIVIDUALS INTERVIEWED

During the course of this assessment of design standardization, we consulted with numerous private firms and government and quasi-government organizations. This appendix presents a list of the organizations contacted and the personnel in those organizations who we interviewed.

PRIVATE SECTOR

Detailed Interviews:

Mr. Russell Jordan (V.P. for Business Development, Architecture, and Construction, Marriott Corporation)

Mr. Pasquale B. Camuso (Director of the Hotel Technical Services, Marriott Corporation)

Mr. John Eberhard (Executive Director, Building Research Board)

Mr. John Rynard (Chief of Architecture for Office Buildings, McDonald Corporation)

Mr. Ken Schooler (Chief of Architecture and Construction for Restaurants, McDonald Corporation)

Mr. Ezra Ehrenkrantz (President, The Ehrenkrantz Group, PC)

Mr. Tom Batey (Vice President, Hospital Corporation of America)

Mr. Roger Panther (Assistant Vice President for Programming and Design, Hospital Corporation of America)

General Interviews:

Hospitals

Hospital Corporation of America

Humana, Incorporated

Earl Swenson and Associates

American Hospital Association, Hospital Management Program

Hotels/Motels

Holiday Inn
Ramada Inns, Incorporated
Jack Butz, A.I.A.

Large Retail

J.C. Penney Company, Incorporated
K Mart Corporation

Offices

Oliver T. Carr Company
Austin Company, Incorporated

Supermarkets

Giant Food, Incorporated

Auto Maintenance Facilities

B.F. Goodrich Company
Firestone Tire and Rubber Company

Schools

Fairfax County (VA) Public Schools
Ward Hall and Associates
George Mason University
University of Virginia

Warehouses

Footlick and Associates
Austin Company, Incorporated

DEPARTMENT OF DEFENSE

Mr. Sig Gerber (Former DoD Director of Design)
Mr. Mort Marshall (Former DoD Director of Design)
Mr. Walt Winter (Chief of Engineering and Design for AFSCOM)
Col. Joe L. Hicks (Chief of Construction for the Air Force)
Mr. James Rasor (Chief of Military Construction AFRCE Eastern Region)
Col. Jarrell S. Mitchell (Chief of Engineering for the Air Force)

Mr. Tom Kenney (Architectural and Building Systems Branch OCE)

Mr. Dan Duncan (Architectural and Building Systems Branch OCE)

Mr. Wayne Urbine (Chief of Military Design Savannah District COE)

Mr. Harold Hartman (Chief of the Air Force Project Management Branch for Savannah District COE)

Mr. David Killen (Assistant Chief of Design Branch Fort Worth District COE)

Mr. James Risse (Chief of Project Management Branch Fort Worth District COE)

Mr. Robert J. Odello (NCEL)

Mr. Robert Porter (CERL)

Mr. Dave Skar (Director of Engineering Services for NAVFAC)

Mr. Lou Santin (Chief of Military Design Sacramento District COE)

Mr. Hans Marquadt (Deputy Chief of Design Division for WESTDIV)

Col. Ken Grunborg (Chief of Engineering for AAFES)

Mr. Jim Olson (Director of Design for SOUTHDIV NAVFAC)

Mr. Tom Rutherford (Director of Engineering and Design Criteria for NAVFAC)

Mr. Bill Brown (Deputy Chief of Engineering for the Air Force)

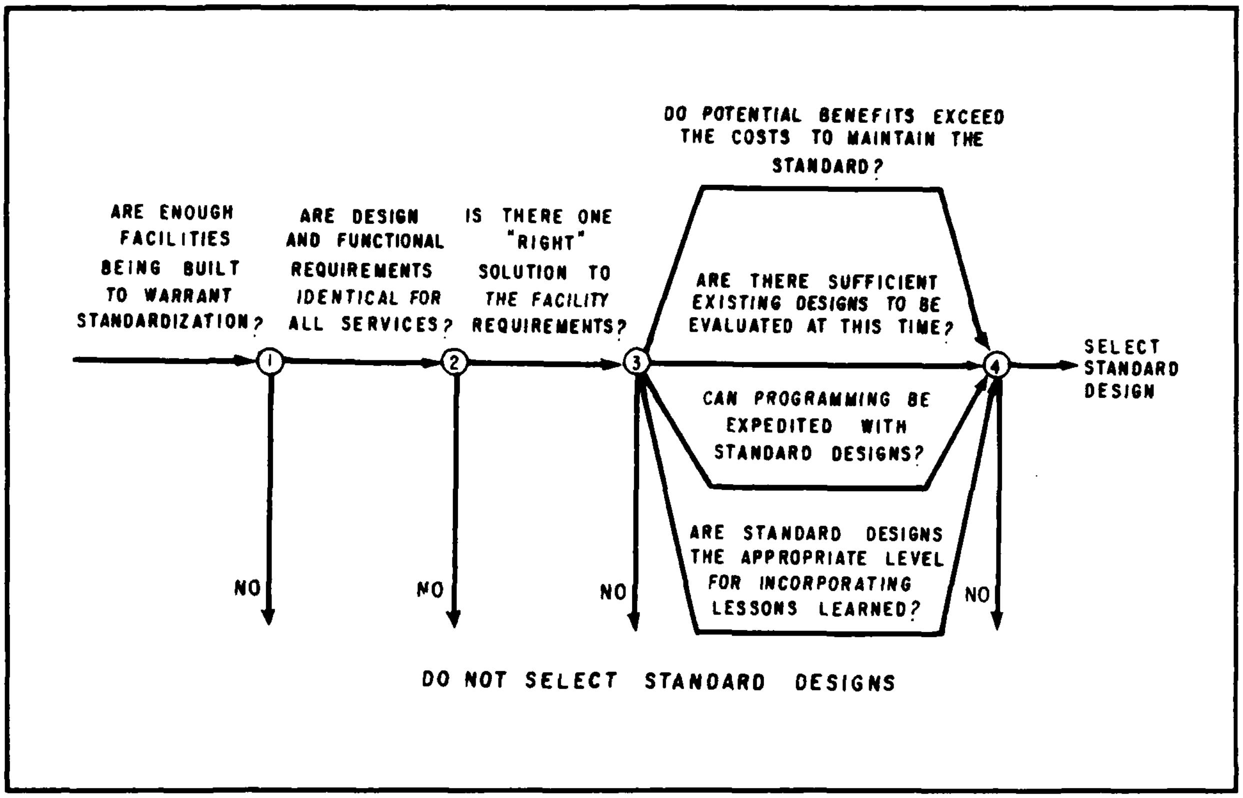
Mr. Richard Malm (Engineer Support Branch OCE)

APPENDIX C

CRITERIA FOR SELECTING THE APPROPRIATE LEVEL OF DESIGN STANDARDIZATION

This appendix describes the processes that must take place at the decision nodes for the evaluation of design standardization at all four levels: standard designs (Level 1), definitive drawings (Level 2), functional modules (Level 3), and design criteria (Level 4). The major issues that must be considered are identified as well as a sense of their relative importance. In presenting the process descriptions, we have discussed the most complex level (Level 1) first and proceeded through decreasing complexity to Level 4. The decision nodes referred to in the text are those numbered in the accompanying figures.

FIGURE C-1. LEVEL 1 STANDARDIZATION: STANDARD DESIGNS



DECISION NODE 1: The number of facilities that DoD expects to build, using standard designs, must be assessed to determine whether the development of standard designs is warranted. If only a small number of the facility type is expected to be built in the next 1 to 5 years, it may not be prudent to expend resources to develop a standard design that will not be used. This decision should not be viewed as an economies of scale check but, rather, as the identification of rarely built facilities.

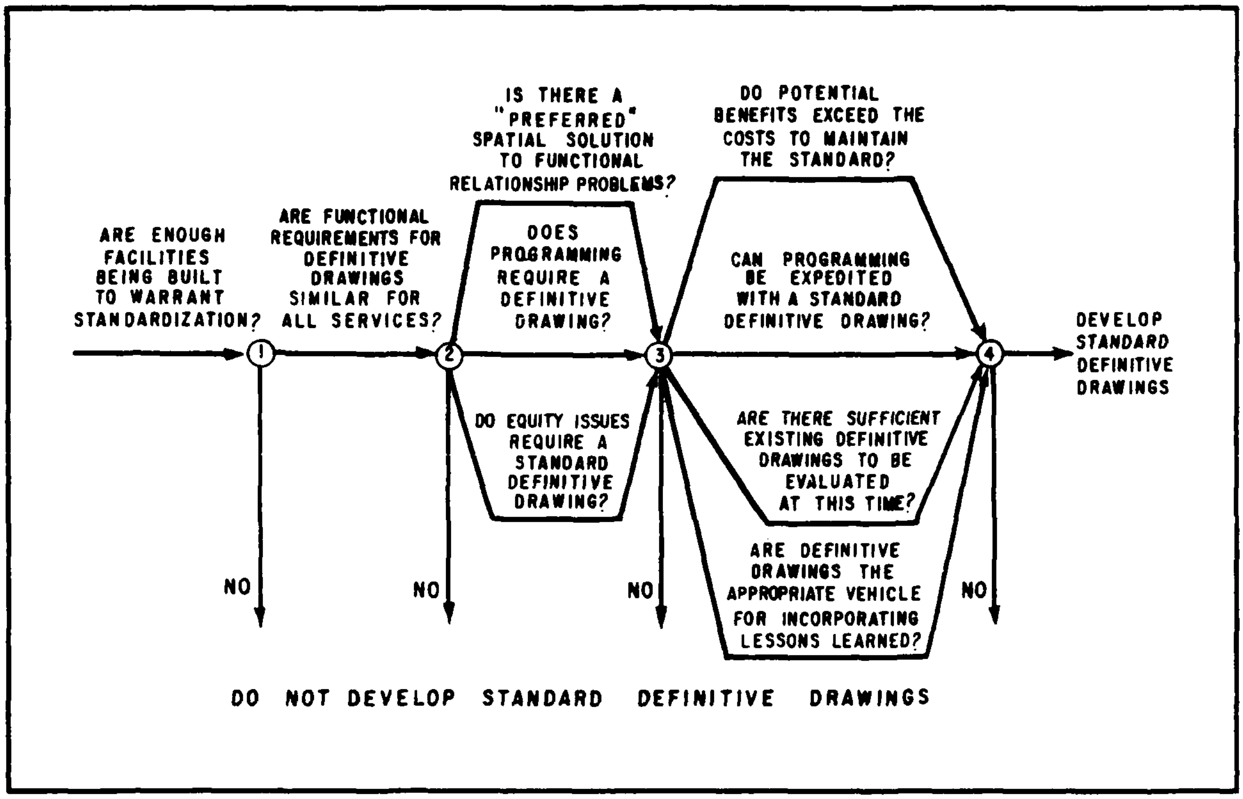
DECISION NODE 2: The use of standard designs is contingent upon the functional requirements for the facility being identical for all Services. This requirement differs from the other levels of standardization where only "similar" functional requirements are needed to proceed with use of a standard. The reason for this difference is that successful use of standard designs necessitates a much higher degree of consistency with regard to functional requirements than does successful use of any of the other levels of standardization.

DECISION NODE 3: The concept of a "right" solution refers to the existence of a standard design that represents a DoD-preferred solution to the facility requirements. It may not be the only solution, but it is one that is measurably better than others. The use of a standard design is often inappropriate if there is no "right" solution for the facility type.

DECISION NODE 4: The final decision requires the simultaneous consideration of four factors that address costs and benefits, programming efficiency, the number of existing designs, and the treatment of feedback. Potential costs and benefits should be analyzed to assess whether the benefits of standardization exceed the costs. Some of the costs and benefits may have to be examined qualitatively if the identification of quantitative amounts is not possible. Programming efficiency will normally improve with the existence of standard designs because of the reduced number of false starts and miscommunications. A sufficient number of existing designs should be available to permit evaluation and subsequent selection of a standard. If enough samples of standard designs from existing projects are not available, a standard design has to be developed. The treatment of feedback is extremely important and an analysis of how it would be accomplished with the standard design should be performed.

The relative importance of these factors varies with facility type. A qualitative assessment is necessary to establish the relative importance as part of the decision process.

FIGURE C-2. LEVEL 2 STANDARDIZATION: DEFINITIVE DRAWINGS



DECISION NODE 1: The number of facilities that DoD expects to build using definitive drawings must be assessed to determine whether the development of definitive drawings is warranted. If only a small number of the facility type is expected to be built in the next 1 to 5 years, it may not be prudent to expend resources to develop definitive drawings that will not be used. This decision should not be viewed as an economies of scale check but, rather, as the identification of rarely built facilities.

DECISION NODE 2: The use of definitive drawings is contingent upon the functional requirements for the facility being similar for all Services. The required degree of similarity is dependent, to a large extent, on the facility type. The functional requirements do not have to be identical, but they do need to be similar for definitive drawings to be effective.

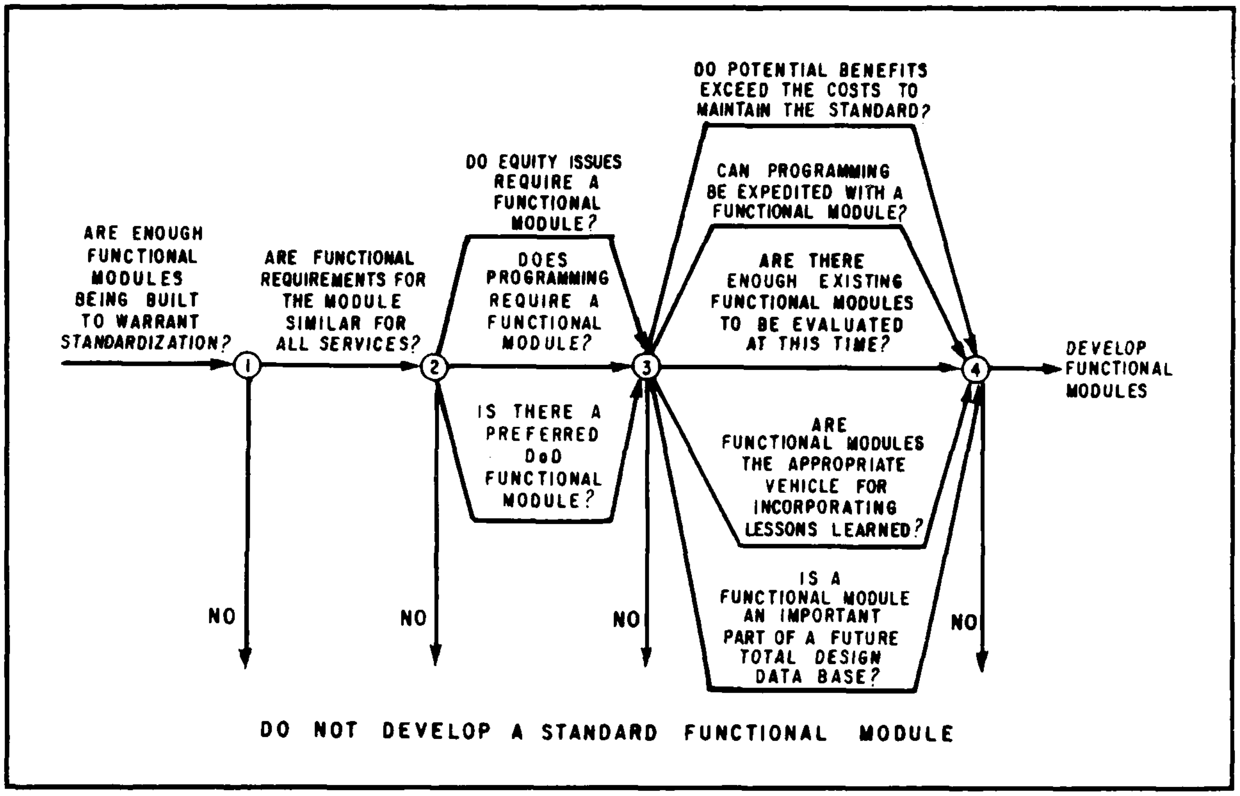
DECISION NODE 3: Equity issues, programming requirements, and the existence of a preferred solution should be considered simultaneously. Equity issues refer to the need to provide the same quality of facility to every Service member regardless of branch. Programming requirements refer to the need for consistency in the programmed requirements for the facility type. They also relate to the need to shorten the time required to develop programming documents that would use definitive drawings as the starting point. The concept of a preferred solution refers to the existence of a definitive drawing (spatial solution) that represents a DoD-preferred solution to the facility requirements. It may not be the only solution, but it is one that works and is preferred.

The relative importance of these three issues varies from facility type to facility type. For example, equity is a major concern in housing, whereas the existence of the most efficient layout may be critical for a maintenance or production facility. A qualitative assessment of the relative importance of these factors must be made for each facility type. Depending upon the relative importance of the factors, a "yes" for one factor could override negative responses for the other two, or conversely, a "no" on the most important factor could override two positive responses on less-important factors.

DECISION NODE 4: The final decision requires the simultaneous consideration of four factors. These factors address costs and benefits, programming efficiency, number of existing definitive drawings, and the treatment of feedback. Potential costs and benefits should be analyzed to assess whether the benefits of standardization exceed the costs. Some of the costs and benefits may have to be examined qualitatively if the identification of quantitative amounts is not possible. Programming efficiency will normally improve with the existence of definitive drawings because of the reduced number of false starts and miscommunications. A sufficient number of definitive drawings, or examples, should exist to permit evaluation and subsequent selection of a standard. If enough sample definitive drawings are not available from existing projects, a standardized definitive drawing has to be developed. The treatment of feedback is extremely important and an analysis of how it would be accomplished with the definitive drawing should be performed.

The relative importance of these factors varies with facility type. A qualitative assessment is necessary to establish the relative importance of each factor as part of the decision process.

FIGURE C-3. LEVEL 3 STANDARDIZATION: FUNCTIONAL MODULES



DECISION NODE 1: The number of facilities that DoD expects to build using a functional module must be assessed to determine whether development of the functional module is warranted. If only a small number of the facility type is expected to be built in the next 1 to 5 years, it may not be prudent to expend resources on developing a functional module. This decision should not be viewed as an economies of scale check but, rather, as the identification of rarely built facilities.

DECISION NODE 2: The use of a standardized functional module is contingent upon the functional requirements for the module being similar for all Services. The required degree of similarity is dependent, to a large extent, on the facility type. For maintenance facilities, the equipment and service load would have to be the same; for barracks, the space allocations and housing philosophies would have to be similar. The functional requirements do not have to be identical, but they do need to be similar if the use of functional modules is to be effective.

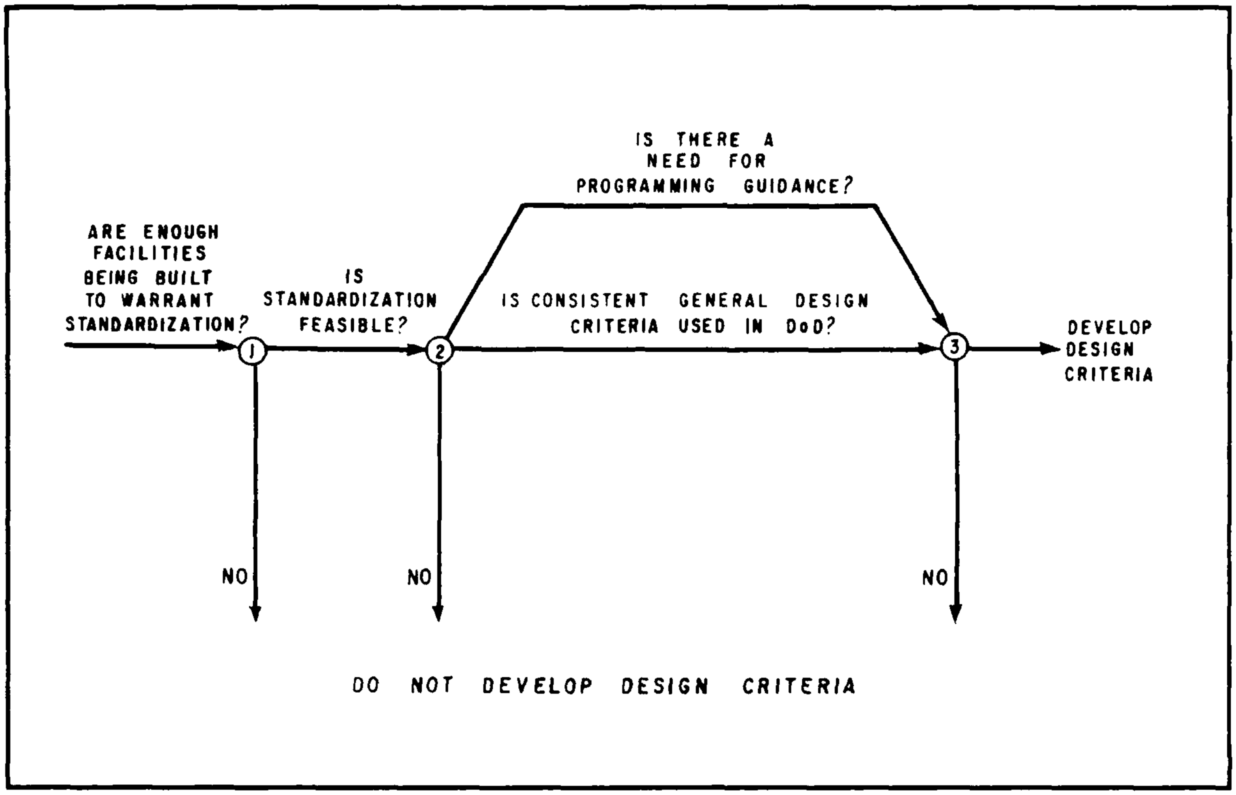
DECISION NODE 3: Equity issues, programming requirements, and the existence of a preferred DoD solution should be considered simultaneously. Equity issues refer to the need to provide the same quality of facility to every Service member regardless of branch. Programming requirements refer to the need for consistency in the programmed requirements for the facility type. They also relate to the need to shorten the time required to develop programming documents that would use modules as a starting point. The concept of a preferred DoD solution refers to the existence of a functional module that represents a DoD-preferred solution to the facility requirements. It may not be the only solution, but it is one that works and is preferred.

The relative importance of these three issues varies from facility type to facility type. For example, equity is a major concern in housing, whereas the existence of the most efficient layout may be critical for a maintenance or production facility. A qualitative assessment of the relative importance of these factors must be made for each facility type. Depending upon the relative importance of the factors, a "yes" for one factor could override negative responses for the other two, or conversely, a "no" on the most important factor could override two positive responses on less-important factors.

DECISION NODE 4: The final decision requires the simultaneous consideration of five factors. These factors address costs and benefits, programming efficiency, number of existing modules, feedback, and the tie-in to a total design data base. Potential costs and benefits should be analyzed to assess whether the benefits of standardization exceed the costs. Some of the costs and benefits may have to be examined qualitatively if the identification of quantitative amounts is not possible. Programming efficiency will normally improve with the existence of a functional module because of the reduced number of false starts and miscommunications. A sufficient number of modules, or examples, should exist to permit evaluation and subsequent selection of a module. If enough sample modules are not available from existing projects, a standardized module has to be developed. Feedback and the tie-in with a future total design data base should also be considered. The treatment of feedback is extremely important and an analysis of how it would be accomplished with the module should be performed. Similarly, the tie-in with a future total design data base and CADD should be assessed and considered in the decision-making process.

The relative importance of these factors varies with facility type. A qualitative assessment is necessary to establish the relative importance of each factor as part of the decision process.

FIGURE C-4. LEVEL 4 STANDARDIZATION: DESIGN CRITERIA



DECISION NODE 1: A sufficient number of facilities must be built to warrant expending the resources to develop design criteria. In almost all cases, sufficient facilities will be built because of the size of the DoD program; however, for some special-purpose facilities only used by one Service, it may not be reasonable for DoD to develop and maintain design criteria.

DECISION NODE 2: A qualitative assessment must be made as to whether or not standardized design criteria for the facility type is feasible at the DoD level. In most cases, the answer to this question will be yes, but again, some special-purpose, Service-specific facilities for programs such as the Trident submarine, the Strategic Defense Initiative (SDI), etc., are not feasible to standardize at the DoD level.

DECISION NODE 3: The need for programming guidance should be considered along with the consistency of existing design criteria for the facility type. No weightings are given to assess the relative importance of the two factors; rather, a joint qualitative assessment of both should be made. A negative response to either question alone does not imply a "no" for the node as a whole.

APPENDIX D

EXAMPLE

Level 1 standardization for unaccompanied personnel housing is a complete standardized design. The standard design would include all construction drawings, general contract provisions, standard contract provisions, and the technical provisions (material and construction specifications). The standard design would be capable of being adapted to any site. An artist's rendition of the completed facility is shown (Figure D-1).

Level 2 standardization for unaccompanied personnel housing would require a standardized definitive drawing for the facility (Figure D-2). The amount of detail presented on the definitive may vary. The minimum amount of detail needed for an effective definitive is shown in this example. Additional detail could be added depending upon the needs of the user. The key points that the definitive must portray at a minimum are the spatial relationships of spaces and the relative sizing of the spaces.

Level 3 standardization for unaccompanied personnel housing would require a standardized functional module (Figure D-3). The functional module, or modules, may or may not include dimensions, but should include the space arrangements within the module at a minimum. The example shows three functional modules for barracks, each of which addresses a different housing requirement.

Level 4 standardization for unaccompanied personnel housing would require standardized design criteria (an example is shown on pages D-5 and D-6). The amount of detail needed in the design criteria is a function of the facility type. In the example, some specifics on space authorizations are given along with some general design guidance.

FIGURE D-1. EXEMPLARY STANDARD DESIGN (LEVEL 1 DESIGN STANDARDIZATION) FOR UNACCOMPANIED PERSONNEL HOUSING

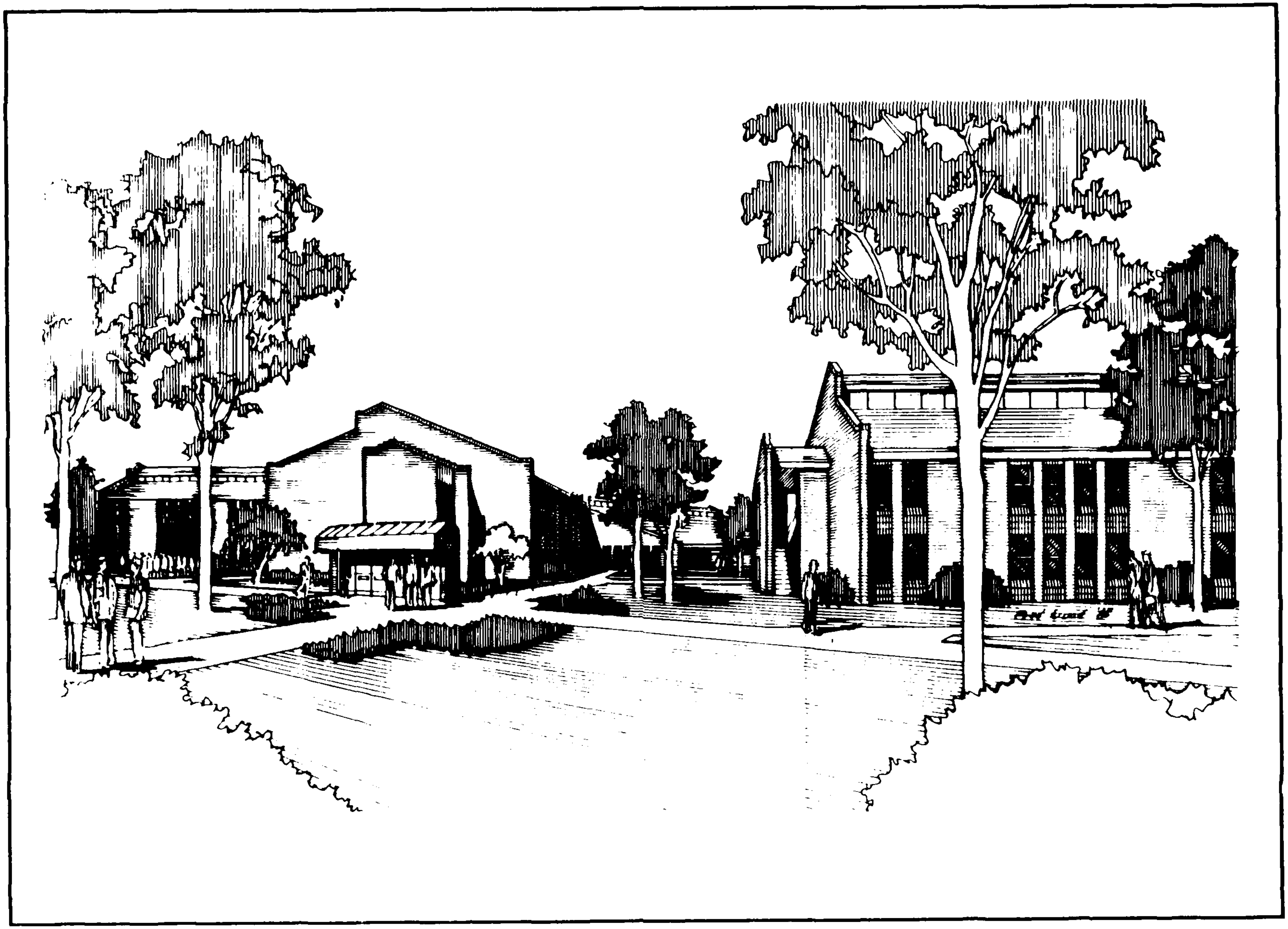


FIGURE D-2. EXEMPLARY DEFINITIVE DRAWING (LEVEL 2 DESIGN STANDARDIZATION) FOR UNACCOMPANIED PERSONNEL HOUSING

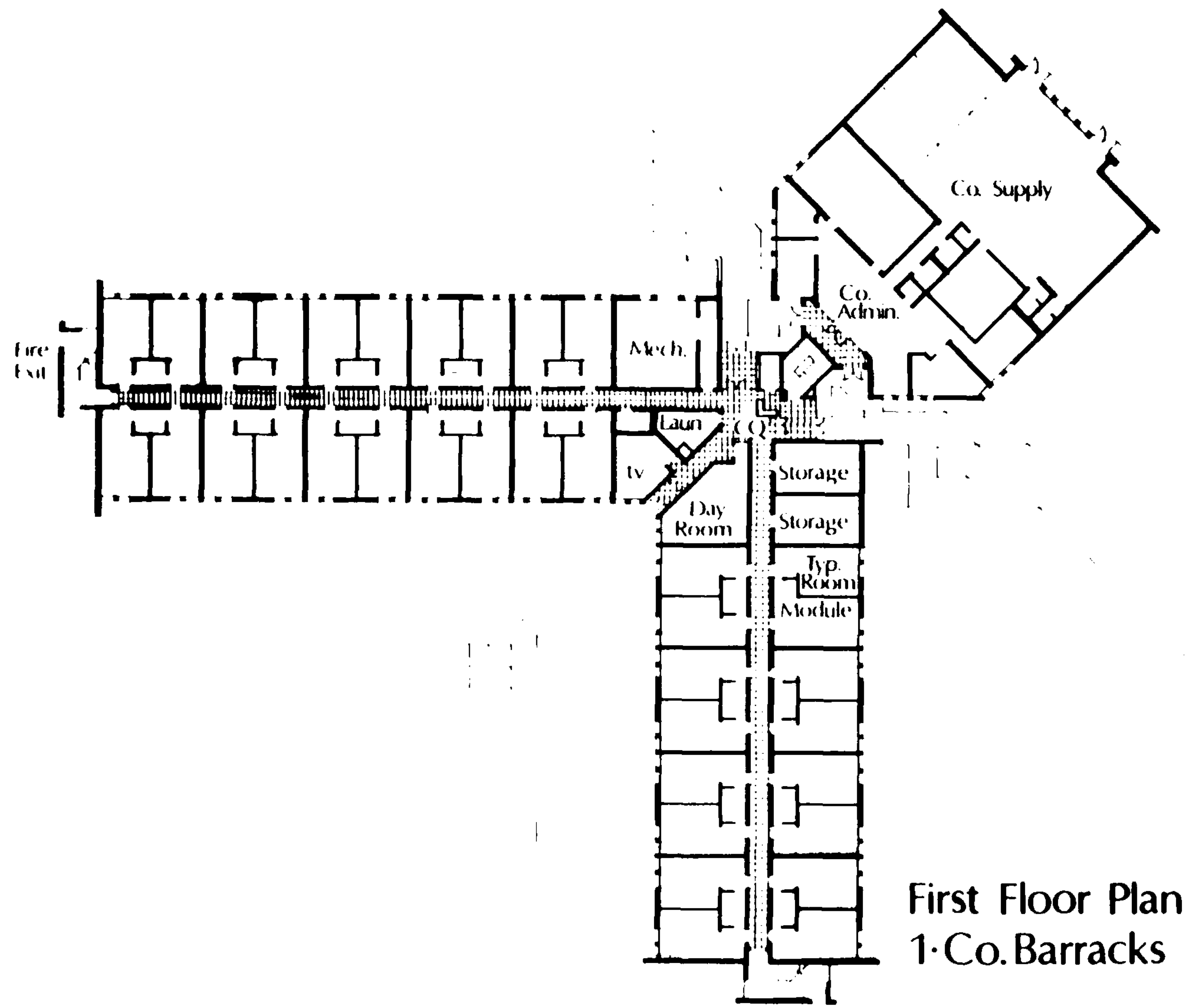
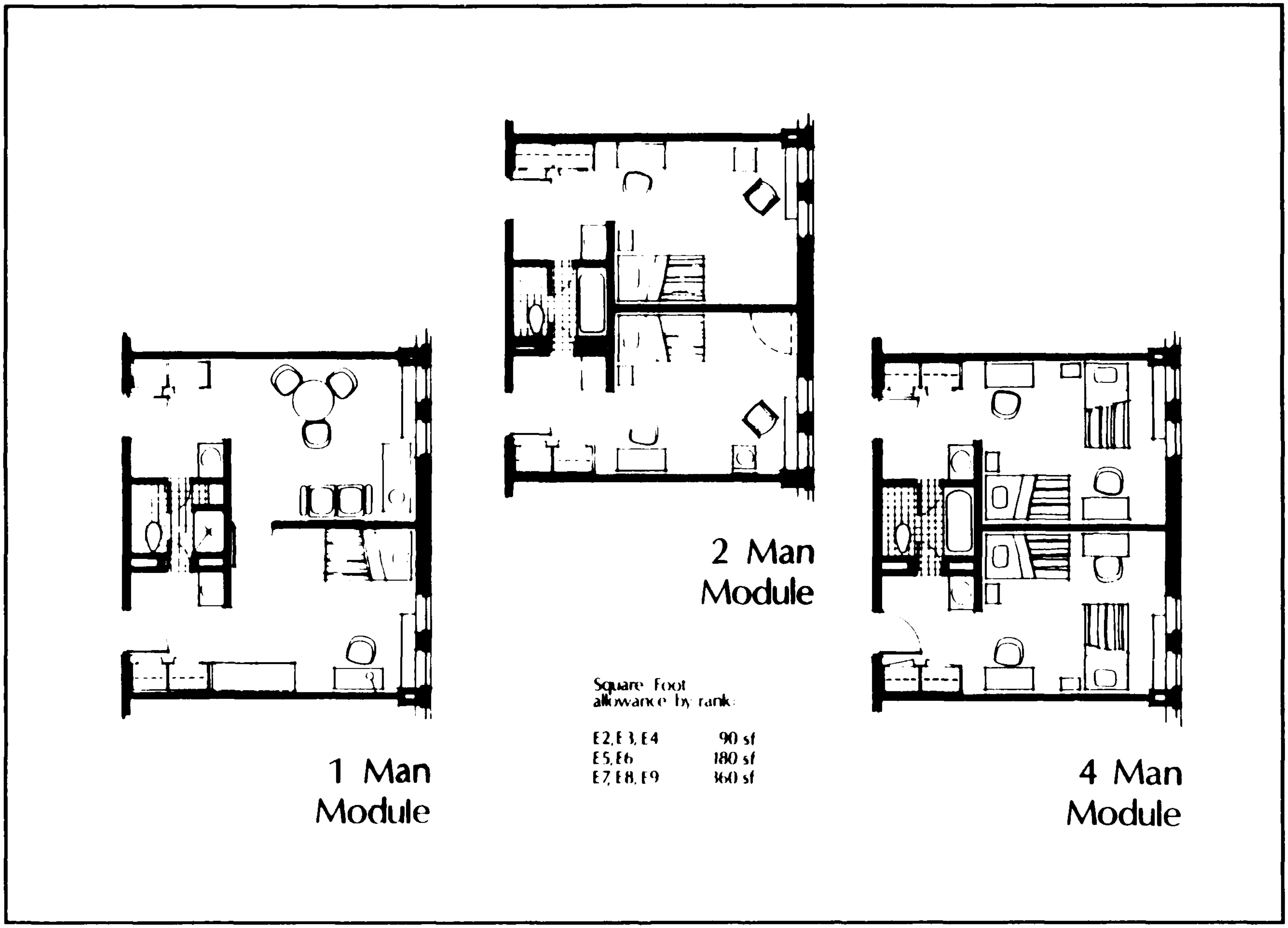


FIGURE D-3. EXEMPLARY FUNCTIONAL MODULE (LEVEL 3 DESIGN STANDARDIZATION) FOR UNACCOMPANIED PERSONNEL HOUSING



3.4 Unaccompanied Officer Personnel Housing (UOPH).

A. Space Criteria and Accommodations shall be as follows:

1. Grades 02 and Below: The net living area of each private suite shall closely approximate 330 ft^2 [31 m^2]. The allowable gross building area shall approximate 475 ft^2 [43 m^2] per officer. Accommodations shall consist of a living room, bedroom, bathroom, and kitchen.

2. Grades 03 and above. The net living area of each private suite shall closely approximate 460 ft^2 [43 m^2]. The allowable gross building area shall approximate 650 ft^2 [60 m^2] per officer. Accommodations shall consist of a living room, bedroom, bathroom, and kitchen.

3. Net living area is measured from the inside face of the peripheral wall of the suite and includes all spaces and partitions thereby enclosed.

B. Design

1. General Guidance in designing specific projects, appropriate space shall be allocated for common use and service type facilities such as lounges, vending machines, control offices, central storage linen rooms, cleaning equipment rooms, entries and circulation, mechanical equipment and other similar items which may be required, in order that the complete facility will reflect the lowest practicable gross area compatible with adequate accommodations.

2. Capacity of UOPH Buildings. In the interest of economy, UOPH buildings normally shall be of large capacity (100 or more persons). Incremental construction of small capacity facilities shall not be undertaken when long range requirements can be consolidated by adjustments in programming.

C. Elevators. Passenger and freight elevators shall not be provided in UOPH buildings less than four stories in height.

D. Cost Limitations. For the purpose of determining compliance with the applicable congressional limitation, the cost of a UOPH building shall comprise the complete cost of the building to the 5 ft [1500 mm] line, less the costs of design and engineering and unusual costs such as pile foundations and seismic construction, but including the costs of heating, mechanical ventilation, evaporative cooling, air conditioning, and individual personal storage lockers, closets, and wardrobes (whether built-in or free standing).

E. Improvement Projects for UOPH. The objective for all improvement projects shall be to achieve the new construction standards indicated in paragraph 3-4.2A. All necessary improvements to a facility to achieve required standards shall be accomplished as one project. Phased construction, over a period of years, shall not be used to bring a facility up to standards. Improvements shall meet the construction criteria contained in this manual.

3.5 Enlisted Personnel Dining Facilities

A. General.

1. The establishment of central kitchen, central food preparation facilities, central pastry kitchens, central bakeries, and meatcutting facilities for an installation's appropriated fund food service program shall be subject to the policies contained in DoD Directive 1338.10 and DoD Directive 4100.33 (references (3e) and (3f)).

2. The policies and procedures for MILCON, O&M and Minor Construction programming established in DoD Directives and Instructions shall be followed for food service facilities.

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This study examines the standardization of facility designs. Different levels or degrees of design standardization are identified and defined. The major issues concerning standardization are identified as well as the advantages and disadvantages of design standardization. The study recommends that DoD adopt a design standardization program that employs a matrix approach. The program recommended would result in an integrated, user-oriented approach to facility design standardization.

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